AL/OE-TR-1996-0027

EIELSON AIR FORCE BASE INFILTRATION POND STUDY

Paul J. Fronapfel, 1LT, USAF, BSC

ARMSTRONG LABORATORY

OCCUPATIONAL AND ENVIRONMENTAL HEALTH DIRECTORATE
Bioenvironmental Engineering Division
2402 E Drive
Brooks Air Force Base, TX 78235-5114

March 1996

Final Technical Report for the Period 24-28 July 1995

Approved for public release; distribution is unlimited.

AIR FORCE MATERIEL COMMAND
BROOKS AIR FORCE BASE, TEXAS

NOTICES

When government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United States Air Force.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

Government agencies and their contractors registered with Defense Technical Information Center (DTIC) should direct requests for copies to: Defense Technical Information Center, 8725 John J. Kingman Rd, STE 0944, Ft Belvoir, VA 22060-6128.

PAUL J. FRONAPFEL, 1Lt, USAF, BSC
Consultant, Water Quality Branch

JAMES D. MONTGOMERY, Lt Col, USAF, BSC
Chief, Bioenvironmental Engineering Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1996	Final 24-28 July 1995

4. TITLE AND SUBTITLE

EIELSON AIR FORCE BASE INFILTRATION POND STUDY

5. FUNDING NUMBERS

6. AUTHOR(S)

PAUL J. FRONAPFEL

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

ARMSTRONG LABORATORY (AFMC)
Occupational and Environmental Health Directorate
Bioenvironmental Engineering Division
2402 E Drive
Brooks AFB TX 78235-5114

8. PERFORMING ORGANIZATION REPORT NUMBER

AL/OE-TR-1996-0027

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The USAF Armstrong Laboratory, Occupational and Environmental Health Directorate, Bioenvironmental Engineering Division, Water Quality Branch (AL/OEBW) was requested by 354 CES/CEV, Eielson AFB (EAFB), AK, to conduct a survey of the infiltration basin at the base's wastewater treatment plant (WWTP). The effluent water from the WWTP discharges to the infiltration pond at an average rate of approximately one million gallons per day (1 MGD). The infiltration basin is a former gravel pit of approximately 18-20 acres in size.

Recently, the pond has been enlarging, and on occasion overflowing onto Central Avenue near the main entrance of the base. In May, 1995, EAFB CES personnel requested OEBW to determine if the infiltration pond has a sludge or soot layer "plugging" the bottom of the pond and causing the overflow conditions. OEBW's goal was to determine the nature and extent of such sedimentation, characterize the material for disposal alternatives, and identify ways to prevent future overflowing.

This report provides the results from permeability and characterization test on the pond sediment and proposes several alternatives for EAFB to handle the infiltration pond problem.

14. SUBJECT TERMS
Wastewater Treatment Plant Infiltration Basin Effluent Permeability Sediment Sedimentation Algae Suspended Solids

15. NUMBER OF PAGES
50

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

TABLE OF CONTENTS

FIGURES

ACKNOWLEDGMENTS

The author expresses his appreciation for the work and support of MSgt Jorge Noverola and SSgt Robert P. Davis in conducting the survey. The Civil and Bioenvironmental Engineering staff at Eielson AFB were helpful and generous with their time, and essential for the completion of this project. Bioenvironmental Engineering staff provided photos for documentation of the height of the infiltration pond water. Chris Lidstone, of Lidstone & Anderson, Inc., generously provided engineering consulting support for this project.

EIELSON AIR FORCE BASE, ALASKA, INFILTRATION POND STUDY

INTRODUCTION

The USAF Armstrong Laboratory, Occupational and Environmental Health Directorate, Bioenvironmental Engineering Division, Water Quality Branch (AL/OEBW) was requested by 354 CES/CEV, Eielson AFB (EAFB), Alaska (AK), to conduct a survey of the infiltration basin at the base's wastewater treatment plant (WWTP). The effluent water from the WWTP discharges to the infiltration pond at an average rate of approximately one million gallons per day (1 MGD). The infiltration basin is a former gravel pit of approximately 18-20 acres in size. Appendix A provides a site location map showing the infiltration basin and its position relative to the WWTP.

Recently, the pond has been enlarging, and on occasion overflowing onto Central Avenue near the main entrance of the base. In May 1995, EAFB Civil Engineering Squadron (CES) personnel requested OEBW to determine if the infiltration pond has a sludge or soot layer "plugging" the bottom of the pond and causing the overflow conditions. OEBW's goal during the 24-28 July 1995 survey was to determine the nature and extent of such sedimentation, characterize the material for disposal alternatives, and identify ways to prevent future overflowing.

SAMPLING METHODOLOGY

OEB personnel used a row boat belonging to the treatment plant to access the infiltration pond. To determine the nature and extent of possible sedimentation, OEB planned to use a sludge judge to measure the depth of the muck on the bottom of the pond at several locations. At each point measurements of water depth would be taken and a core sample of the sediment drawn with either the sludge judge or a ponar dredge (See Appendix D for diagrams of the sampling equipment). The anticipated depth of the water was 10 feet. On-site conditions made the use of the sludge judge impossible, because the water depth was between 15 and 25 feet across the majority of the pond, and the sediment was too consolidated for the sludge judge to penetrate. Thus, OEB could not obtain an accurate measurement of the thickness of the sediment. OEB also had a seven foot long sediment coring tool, but the depth of the water prevented the use of this equipment.

In order to characterize the sediment for disposal alternatives, equal amounts of sludge samples from each sampling location were collected with a ponar dredge and placed into a large glass jar. This composite sample was thoroughly mixed, and aliquots taken and placed in the appropriate sample containers for Toxicity Characteristic Leachate Procedure (TCLP) analyses. The TCLP procedures included metals, pesticides, herbicides, volatile and semivolatile organic compounds, and reactivity. OEB personnel took duplicate samples for quality control purposes to insure the reproducibility of the analytical results.

To assess the permeability of the sediment, OEB personnel attempted to conduct an on-site test. In this procedure, water is placed on top of a column of the sediment, and the time for the water level in the test column to fall a specified distance is measured. Figure 1, below, illustrates the method.

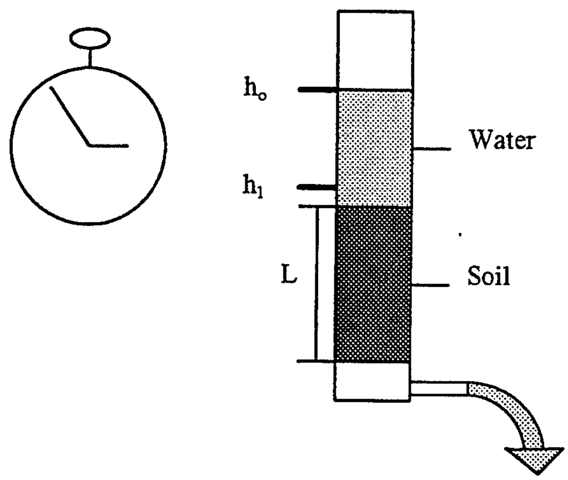


FIGURE 1.
FALLING HEAD PERMEABILITY TEST

The hydraulic conductivity of the soil, k, is calculated by the equation, $k = L/t \ln(h_o/h_1)$, where t is the amount of time it takes the water level to drop from h_o to h_1 (Adapted from Freeze & Cherry, 1979), and L is the length of the soil column.

The low conductivity of the sample, however, made it impossible to conduct this test in the field because there was no visible migration of the water through the sludge column. Thus, OEBW sent a batch of the sludge to the Soil and Crop Science laboratory at Texas A&M University. In a similar test, Texas A&M placed an aliquot of the sludge into a plastic double ring infiltrameter, designed by McNeal & Reeve (1964). Water was loaded on top of the sample, and the effluent water volume measured over the course of 5 days to determine the hydraulic conductivity of the sludge. See Appendix B for the laboratory report of the permeability test.

RESULTS AND DISCUSSION

Figure A-1 of Appendix A shows the site location map for the WWTP infiltration basin. It was apparent during the survey that the infiltration pond has become larger than it has historically been. Figure A-2 Shows the approximate shoreline location during the survey. A barbed wire fence around the original perimeter of the pond was almost completely submerged in the water at the time of this survey. WWTP personnel indicated that this fence was entirely above the water in the past. Figures A-3, A-4, and A-5 of Appendix A provide photos taken on 28 September 1995, which show how the water extends beyond the fence line. OEBW believes that the water level was higher during the survey than at the time of these photographs, but does not have pictures for comparison.

Figure A-6 shows the approximate location of sediment samples, and the water depth at each location. The sediment in the infiltration basin was dark green in color and had a mild odor of decaying biological matter. The character and consistency of the sediment was fairly constant throughout the pond, except at locations to where the pond had recently extended. At these locations, OEBW observed significant amounts of coniferous needles, leaves, sticks, and bark or grass, and little collectible sediment. These locations were near the edges of the pond where tree stumps and the surrounding barbed-wire fence protruded from the water. This information, along with past aerial photos, indicate that the pond has not always covered these areas, and that it is, indeed, increasing in size.

All analytes of the Toxic Characteristic Leachate Procedure sediment tests were below regulatory limits. These results indicate that disposal of any dredged material from the pond should

not require any special considerations, because it is non-hazardous. Appendix C provides the analytical results from the laboratory.

The hydraulic conductivity of the pond sediment is on the order of 10^{-5} to 10^{-6} cm/sec. This is in the general range of silt/loess, glacial till, or limestone, dolomite, and sandstone rocks. In comparison, sand and gravel, or karst limestone have conductivities on the order of 1 to 10^{-2} cm/sec (Freeze and Cherry, 1979). Also, 10^{-6} cm/sec is the conductivity often required for material lining a landfill. This indicates that the sediment in the bottom of the infiltration basin is impermeable relative to the underlying sand and gravel. The laboratory results indicate that the conductivity of the sediment might even be less that 10^{-6} cm/sec for a consolidated sample (the sample that OEB submitted to the laboratory was disturbed). The results in Appendix B show that through the duration of the test, the conductivity was decreasing, which is likely due to consolidation of the material.

The water in the pond was dark green in color, apparently due to algal growth. Total suspended solids in the WWTP effluent average about 15 mg/L, which equates to about 8500 pounds of solids per year. The build-up of sediment in the bottom of the effluent pond is likely due to both algal growth and the settling of suspended solids in the effluent water.

Water will flow from the infiltration pond to the underlying water table because the hydraulic head of the pond is greater than the surrounding groundwater. OEB personnel did not measure the elevation of the pond surface relative to the levels of the surrounding water table. Even without this data, however, we can estimate the head required to push 1.0 MGD of water through soil with a hydraulic conductivity of 10^{-6} cm/sec. The size of the pond is approximately 20 acres, with depths ranging up to about 25 feet. OEB personnel could not precisely measure the depth of the sediment in the basin because of the lack of proper sampling equipment, but based on the information we obtained with the sampling dredge and sludge judge, the sediment is at least 4 inches thick across the majority of the pond. Using Darcy's flow equation, which states that flow through a porous media is proportional to the hydraulic conductivity of the media and the head gradient forcing the flow, 7.1 feet of head difference would be required to push one million gallons per day of water into the underlying groundwater. Based on visual observations of nearby ponds not directly receiving wastewater, the hydraulic gradient is no more than a couple of feet over less than a hundred feet (i.e., the surface of the infiltration basin is very close to the surrounding groundwater levels).

Another significant loss of the water can come from evaporation and evapo-transpiration. One million gallons of water per day, spread over 20 acres, equates to a layer about 0.15 inches deep per day (55 inches per year). The annual net precipitation in the Fairbanks area is about one inch per year (12 inches precipitation and 11 inches evapo-transpiration), so evaporation may constitute a significant portion of the wastewater disposal during dry periods (but not on a yearly average). The evaporation rate is not constant throughout the year and depends on water temperatures, atmospheric temperatures, wind speeds, and relative humidity. At times, water may condense onto the pond surface rather than evaporate from it.

Because of the lack of hydraulic potential and the low conductivity of the pond sediment, the pond is enlarging to accept the 1,000,000 gallons per day of water. The effect of the increase in size is dual: the increase in bottom area provides more space for infiltration and the larger surface area allows for increased evaporation. The land surrounding the infiltration basin is more permeable than the main part of the basin, because it does not have a buildup of low conductivity sediment. In addition, if the soil surrounding the pond boundaries is not saturated with water, capillary suction will increase the infiltration rate at the edges of the pond. Thus, small increases in the pond size might significantly increase the infiltration rate.

Another important consideration is the effect of permafrost on the infiltration capacity and other characteristics of the basin. Surrounding permafrost may inhibit percolation of the water into the surrounding soil, further contributing to the enlargement of the infiltration pond. The effect of permafrost on the migration of contaminants through the groundwater should also be considered in any detailed studies of the WWTP effluent water quality. Surrounding groundwater monitoring wells have shown concentrations of metals, ammonia, and nitrates, potentially from the wastewater, but, as stated before, the sediment did not show evidence of contamination. Metals in this water may also come from background (natural) sources.

CONCLUSIONS

The infiltration pond at EAFB has a significant layer of relatively impermeable sediment which appears to be due to several years' worth of biological (algae) and suspended solids (TSS) settling and sedimentation. This sediment is likely a contributing factor to the increase in area of the infiltration pond because it is essentially plugging up the system. Below are listed several options to approach the problem of the enlarging infiltration pond.

Options

1. EAFB could dredge the sediment from the bottom of the infiltration basin, effectively increasing the capacity of the basin to accept the wastewater. The dredged material is non-hazardous and should not pose a disposal problem. Assuming that there are four inches of sediment stretching over about 15 acres (tree stumps cover the shallow parts of the pond), about 8100 cubic yards of material would need to be removed. This material would increase in volume due to the unconsolidating effect from dredging, but has a high water content, and may compact significantly with dewatering. Because of the non-hazardous nature of the material, it could be disposed of by land application. The specifics of the disposal would need to be coordinated with the state, regardless of the non-hazardous nature of the material.

2. An alternative to dredging and removing the material would be to scrape the bottom of the basin with some sort of drag link to break up the consolidated material, thus 'unplugging' the system. Breaking up the compacted layers of the sediment would increase the permeability and increase the capacity for the basin to accept the wastewater. This would be a short-lived solution because the material would eventually re-deposit on the bottom of the pond and need scraped again.

3. In order to increase the head potential driving the water into the underlying groundwater, and to eliminate flooding, EAFB could construct a berm around the perimeter of the pond, which would essentially increase the depth of the basin. This would also require that the piping which brings the effluent to the infiltration pond be redone to be compatible with the higher water surface. This option would not eliminate the muck, or the formation of more layers of muck on the bottom of the pond, but would enhance the infiltration through the sediment by increasing the driving potential. CH_2MHill estimated, in a January 1995 report, that this project would cost approximately $200K. If the pond were also dredged, the sediment could be used for berm material after dewatering. This would eliminate most disposal concerns.

4. EAFB could dispose of the wastewater effluent to a local waterway, such as Garrison Slough. This would eliminate the problem of the pond water flowing onto the base road (unless flooding is due only to water table fluctuations). This option, of course, would require the treatment plant to complete an application for a NPDES permit and to consider the impact of the effluent on the waterway. The historical analytical data for the wastewater might be adequate for developing such a permit. The plant would also have to construct adequate piping to direct the flow to the slough.

One concern with this option is that high ammonia and nitrate levels in the wastewater might be detrimental to the receiving waterway. For this reason, a denitrification process might have to be added to the treatment process at the plant. However, nitrates migrate easily in groundwater, and have already been found at high levels in monitoring wells near the effluent pond. Migration of this contamination to nearby waterways might occur in the near future, stemming a requirement to control nitrate levels in the wastewater effluent anyway, regardless of whether EAFB discharges directly to the waterway or indirectly via infiltration to groundwater.

5. In addition to any of the above options, EAFB could propose to the State of Alaska the use an algaecide (such as copper sulfate) to reduce the algal formation in the basin. The thick impermeable sediment on the bottom of the pond appears to be due to buildup of biological mass, most likely algae, over several years. The muck is dark green in color and has the odor of decaying biological matter. The rate of sedimentation could be reduced by limiting algal growth.

6. EAFB could install several (6-12) stand pipes to handle overflow conditions. Figure 2, below, illustrates this option. The stand pipes would be 12 to 24 inch diameter pipes set below the impermeable layer. The section of the pipe below the sediment layer would be screened or slotted to allow migration of water through this section. When the pond levels reach the height of the influent slots on the stand pipe, the water would percolate into the underlying strata. The bottom sediment would have to be cleaned from the standpipe before the pipes would operate properly. These pipes could be installed near the shore line.

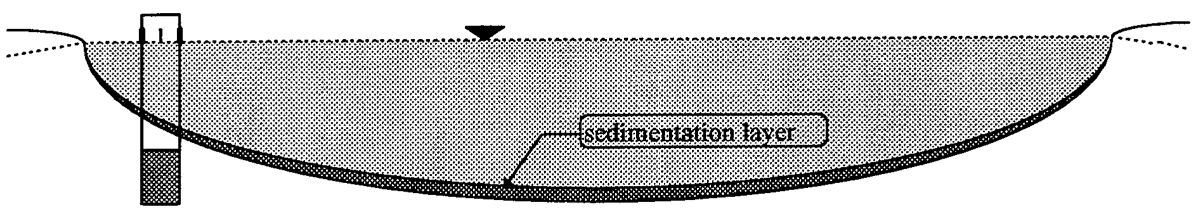


FIGURE 2.
STAND PIPE DIAGRAM

7. One other item worth discussion is denitrification of the wastewater. If EAFB continues to dispose of the WWTP effluent into the infiltration basin, denitrification of the wastewater would reduce the algal nutrient levels in the water. This would lessen the extent of algae formation and reduce the rate of sedimentation. In addition, this additional treatment step would reduce the TSS levels in the wastewater, providing even further reduction in the sedimentation rate in the basin. If EAFB chooses to dredge or scrape the basin, the reduced sedimentation rate would increase the interval between such operations.

8. EAFB could take no action at this time except to monitor the levels of the pond for at least one year. During the spring season of 1995 EAFB experienced unseasonably warm weather and rapid melting of snow and ice. OEB personnel were TDY to Eielson in April 1995 and witnessed several feet of snow melt in less than one week. This might have been a cause of a rapid increase in ambient water table levels, which would have decreased the capacity of the infiltration basin to accept the wastewater, thus causing it to enlarge. Monitoring the levels of the effluent pond relative to the

surrounding groundwater would give insight into the extent of the problem due to the sedimentation, and that due to natural groundwater fluctuations.

RECOMMENDATIONS

At this time, OEBW recommends that EAFB follow Option 8, described above. EAFB should install some sort of datum pole to gage the level of the water in the infiltration basin, and take weekly or bi-weekly readings throughout the course of a year or more to determine trends in the level. This data can be compared with plant flow rates and surrounding monitoring well levels to better determine the driving factor causing the pond to enlarge. Obviously, as the pictures of the pond show, the pond has increased in size well past the fence line. It is difficult to determine how much influence the sedimentation in the pond has on the increase in size as compared to the influence of ambient groundwater levels and evaporation rates. OEB also recommends discussing the available options with the state, allowing the state an opportunity to respond or recommend a course of action.

If the State of Alaska requires EAFB to take some action immediately, OEB recommends constructing berms around the pond and/or dredging or scraping the bottom of the pond to increase the infiltration capacity and to prevent flooding. These actions would be more easily implemented than changing the discharge to a nearby waterway.

If EAFB wishes to gain a better understanding of the hydrogeology of the pond, and obtain a more detailed study of the options for wastewater disposal, OE maintains five on-line contractors who could be used to conduct such studies. OEB appreciates the opportunity to work with Eielson Air Force Base and Pacific Air Forces.

REFERENCES

1. Cherry, John A. and R. Allan Freeze. 1979. *Groundwater.* Prentice-Hall, Inc., New Jersey.

2. CH_2MHill. 1995. Phase I Report, Environmental Engineering Wastewater System Evaluation and Assistance Program, Eielson Air Force Base, Alaska.

3. Eielson Air Force Base 354 CES/CC. April 1994. EAFB WWTP Interim Assessment Report.

4. Pacific Air Forces Comprehensive Plan, Base Layout, Eielson Air Force Base Tab No C-1, Sheet 1 of 6. March 1987.

5. Red Samm Construction, Inc. December, 1994. Eielson Air Force Base Sewage Treatment Plant Operational Dye Test, Final Report.

6. Thomann, Robert V. and John A. Mueller. 1987. *Principles of Surface Water Quality Modeling and Control.* Harper & Row, Publishers, New York.

APPENDIX A

Site Maps

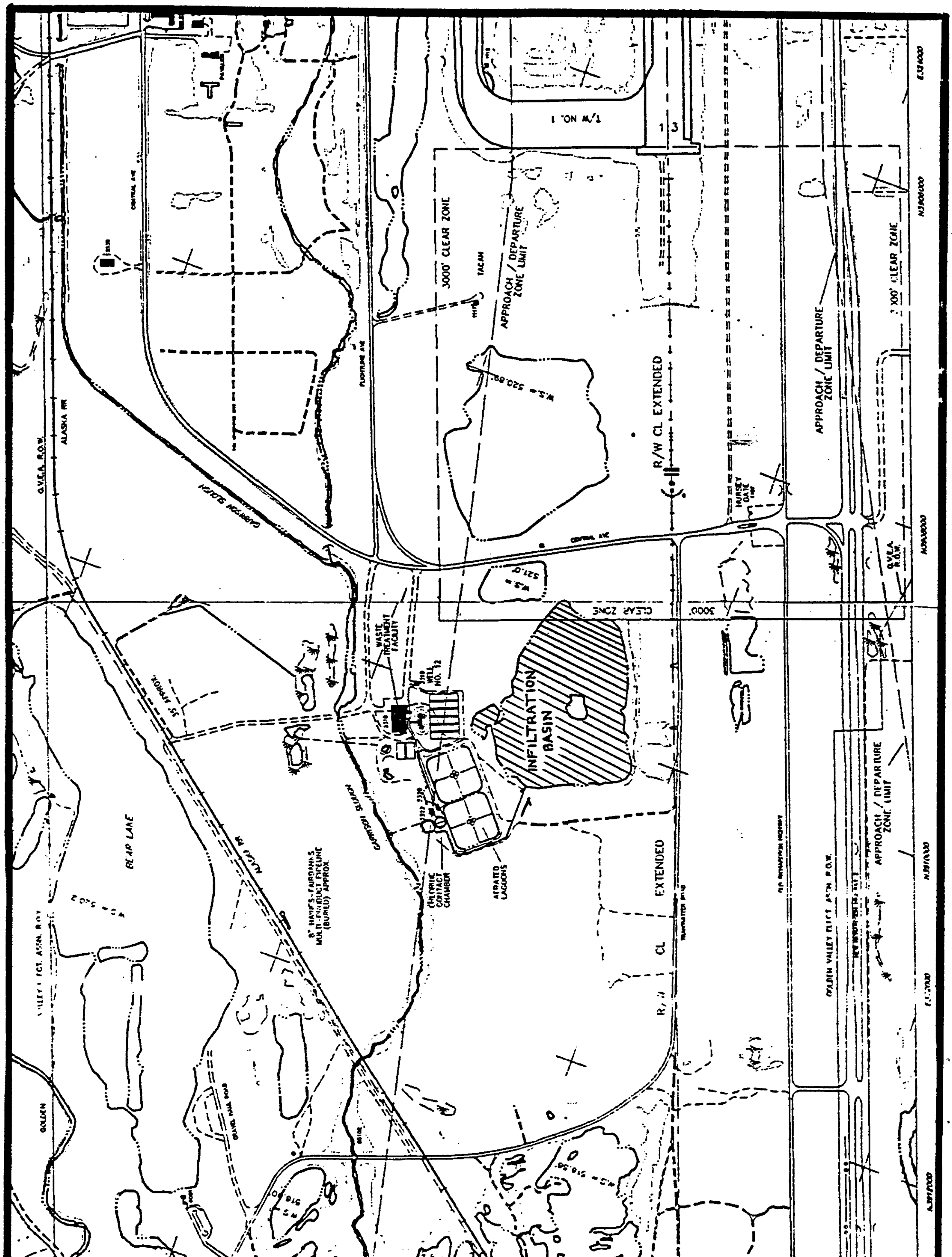


FIGURE A-1 SITE LOCATION MAP

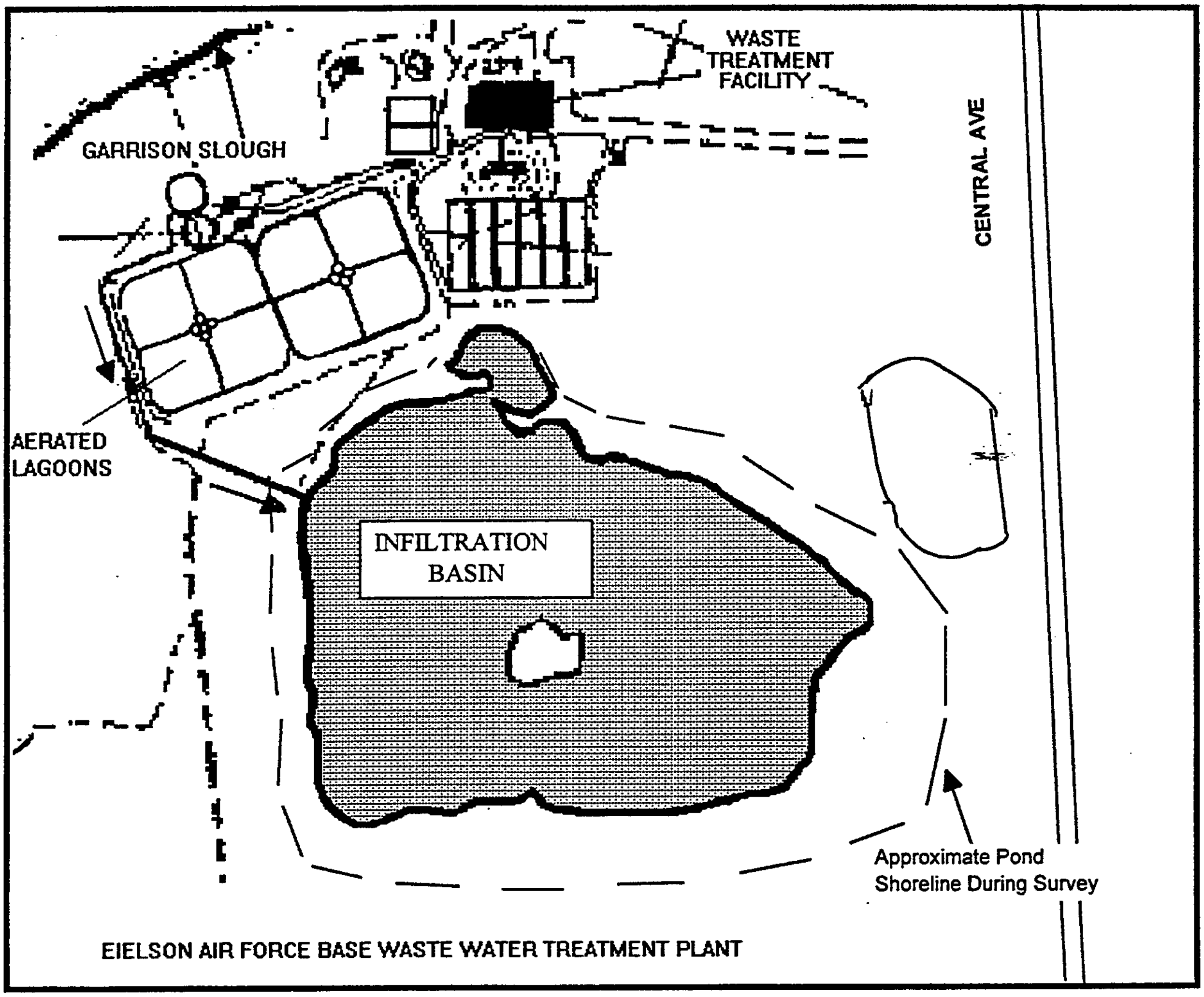


FIGURE A-2

INFILTRATION BASIN

FIGURE A-3

WEST END OF POND, 28 SEP 95

(Dotted line shows fence location)

FIGURE A-4

EAST END OF POND, 28 SEP 95

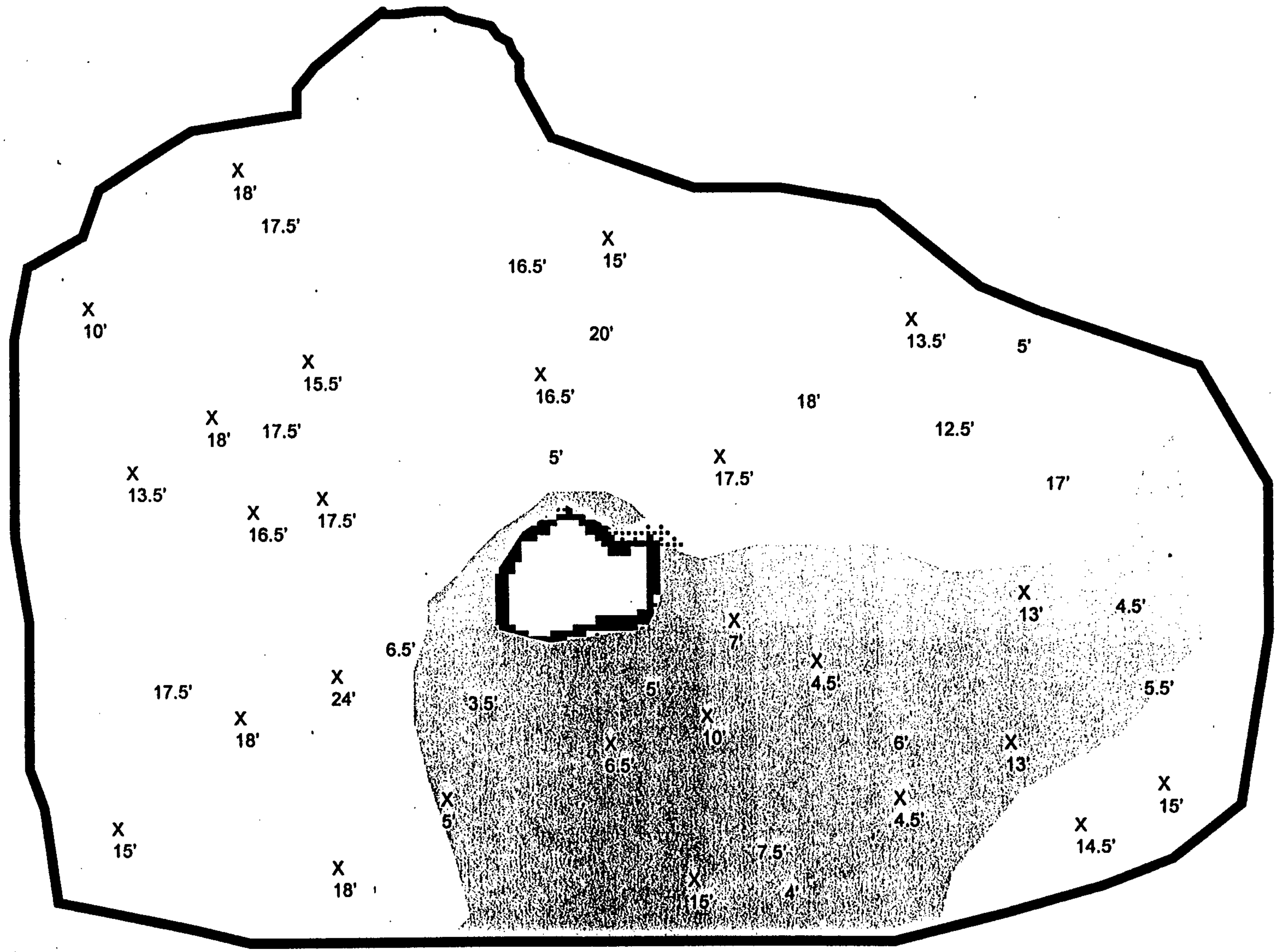
(Dotted line shows fence location)

FIGURE A-5

CENTER OF POND, 28 SEP 95

(Dotted line shows fence location)

FIGURE A-6. INFILTRATION BASIN SAMPLING LOCATIONS AND DEPTH MEASUREMENTS



X - Marks Sampling Location

- Indicates Areas with Tree Stumps

APPENDIX B

Permeability Test Results

TEXAS A&M UNIVERSITY
Soil & Crop Science
College of Agriculture and Life Science
College Station, Texas 77843-2474
FAX (409) 845-0456

August 28, 1995

Lt. Franapfel
2402 East Drive
Brooks Air Force Base
TX 78235-5114

Dear Lt. Franapfel:

As per your phone request and letter of August 10, I have measured the permeability of the muck sample which you submitted. The procedure which was used and the results obtained are as follows:

Procedure:

Muck was removed from the container and placed in a plastic double ring infiltrameter designed by McNeal & Reeve (1964). The inside diameters of the inner and outer rings were 2 and 3 inches, respectively. Muck was added to a finished depth of 1 3/4 inches with very light compaction sufficient only to settle the material. Water was added to a depth of 2 3/8 inches above the soil surface. Effluent from the center ring was collected and measured twice per day. The depth of water was also measured and used to calculate the hydraulic conductivity. All calculations are based on the volume of muck above the inner ring and a total porosity of 50% was used as an estimate of one pore volume.

Results

The hydraulic conductivity as a function of pore volume is presented in the following table and is shown graphically in the attached figure.

Date of Measurement	Cumulative Pore Volume	Hydraulic Conductivity (cm sec^{-1})
8/21/95	0.2	6.5×10^{-5}
8/21/95	1.1	7.6×10^{-5}
8/21/95	1.7	6.5×10^{-5}
8/21/95	2.3	4.3×10^{-5}
8/22/95	3.6	3.0×10^{-5}
8/22/95	4.4	5.0×10^{-5}
8/22/95	5.1	4.7×10^{-5}
8/23/95	6.5	2.5×10^{-5}
8/24/95	7.5	1.2×10^{-5}
8/24/95	7.7	9.3×10^{-6}
8/25/95	8.1	6.1×10^{-6}

The sample had an initial hydraulic conductivity of about 6.5×10^{-5} cm sec^{-1} over the first two pore volumes of effluent. Some particle migration was observed as sediment in the outflow tube and collection vessel. The hydraulic conductivity then showed a steady decrease until by the passage of 8 pore volumes of leachate the conductivity had decreased by 1 order of magnitude to 6.1×10^{-6} cm sec^{-1}

I attribute this decrease to a combination of some slight settling of the lightly compacted sample and the migration of fine colloidal particles into the pores where they inhibit the flow of water. Considerable swelling of the material was also observed over the test period. Thus, I would anticipate this sludge to have an initial conductivity in the range of 6×10^{-5} cm sec^{-1} and that it may decrease by as much as one order of magnitude over time. It is also likely that larger decreases in conductivity could be achieved if the material were compacted after placement. It is also likely that the conductivity will be increased if the sludge is allowed to dry prior to placement.

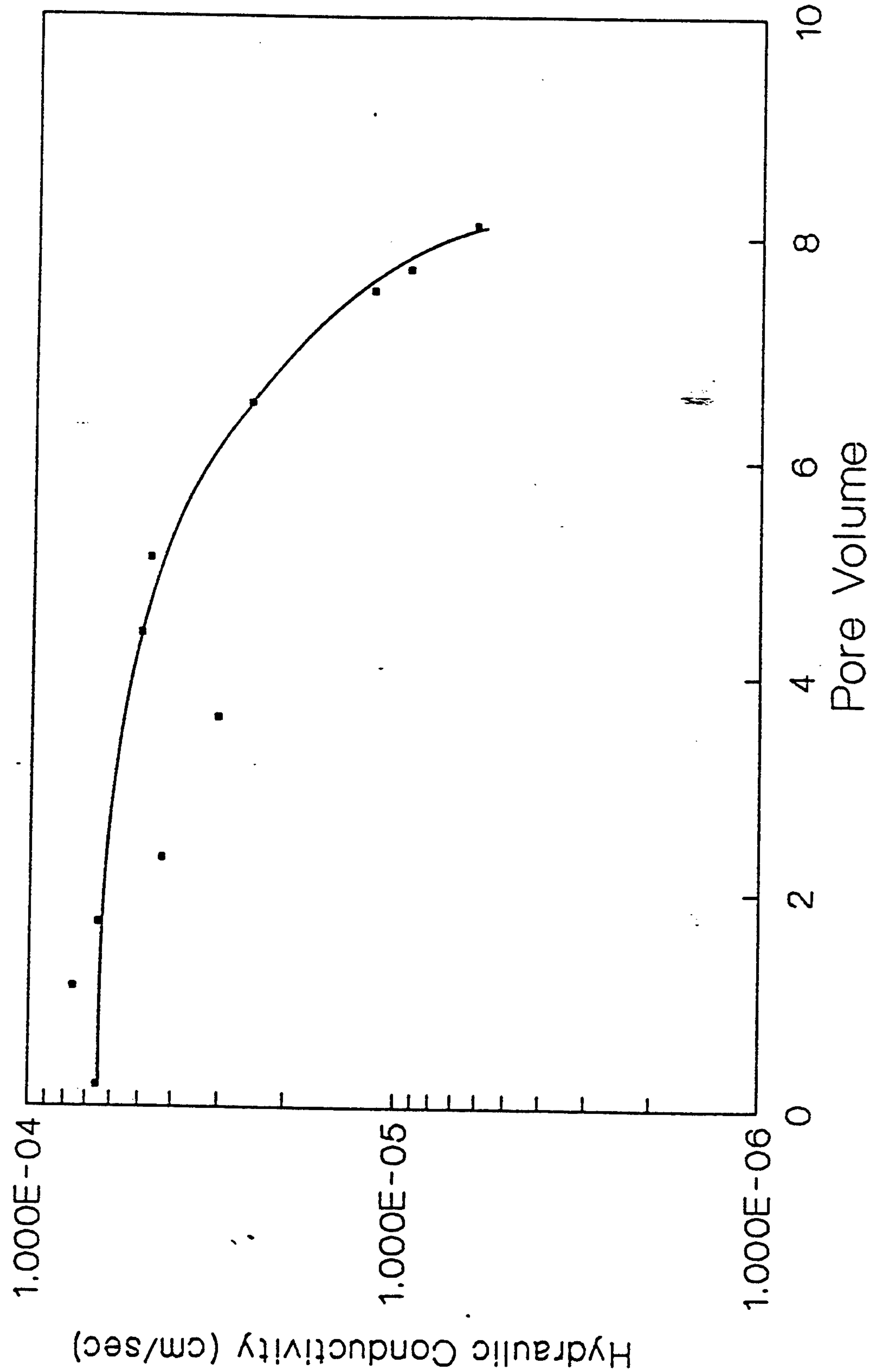
I have returned the sludge to its original container and will retain the sample for 90 days in case you wish to have additional tests performed on it. An invoice in the amount of $75 has been submitted to Clayton Environmental Services as per your instructions.

Please feel free to contact me if you have any questions of if I may be of further assistance.

Sincerely,

James T. Thomas

James C. Thomas
Senior Research Associate



Hydraulic Conductivity (cm/sec)
1.000E-04
1.000E-05
1.000E-06
Pore Volume
0
2
4
6
8
10

APPENDIX C

Analytical Test Results

KEMRON Environmental Services
109 Starlite Park
Marietta, Ohio 45750

Phone: (614) 373-4071

Occupational Env. Health DIR
AL/OEAT
2402 East Drive, Bldg. 140
Brooks AFB, TX 78235-5114
Attn: Sgt. Parrish

Purchase Order: F41622-92-A0106

Order #: N5-08-012
Date: August 15, 1995 11:13
Work ID: 92-AD106-951486/Eielson
Date Received: 07/31/95
Date Completed: 08/14/95

Client Code: BRKAFB_51262

SAMPLE IDENTIFICATION

Sample Number	Sample Description	Sample Number	Sample Description
01	95040770/GL950179	02	95040771/GL950180

All results on solids/sludges are reported "AS RECEIVED" unless otherwise specified. This report shall not be reproduced, except in full, without the written approval of KEMRON.

Tammy R. Hollis

Tammy Hollis
AL Review Chemist

received
950815

AL/OEBW ATTN: TSGT DAVIS
2503 D DRIVE
BROOKS AFB, TX 78235-5102
BRPPKS-OEBE

KEMRON ENVIRONMENTAL SERVICES
RESULTS BY SAMPLE

This is to certify that the following samples were analyzed using good laboratory practices to show the following results.

SAMPLE ID: **01** **95040770/GL950179** Collected: **07/27/95 14:00** Category: **WASTE**

TEST DESCRIPTION	RESULT	DETECTION LIMIT	UNITS	DATE ANALYZED	BY	METHOD
pH (Lab) - Solid Matrix	6.4		S.U.	08/04/95	PJH	9045
Reactivity, Cyanide	<10	10	mg/kg HCN	08/09/95	JWR	846/7.3.3.2
Reactivity, Sulfide	<100	100	mg/kg H2S	08/08/95	SCM	846/7.3.4.1

REQUESTING AGENCY: 92-AD106-951486/Eielson

Test Code: **AFTCME**
Sample Description: **95040770/GL950179**
Test Description: **TCLP Metals**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**

TCLP Extraction Date: 08/02/95
Units: mg/L
Verified: CLC

TCLP ANALYTES

METALS	RESULTS	DETECTION LIMIT	REGULATORY LIMIT	METHOD	PREPARATION DATE	ANALYSIS DATE
Arsenic	ND	1	5.0	SW6010	08/03/95	08/07/95
Barium	1.2	0.1	100.0	SW6010	08/03/95	08/07/95
Cadmium	ND	0.1	1.0	SW6010	08/03/95	08/07/95
Chromium	ND	0.2	5.0	SW6010	08/03/95	08/07/95
Lead	ND	1	5.0	SW6010	08/03/95	08/07/95
Mercury	ND	0.005	0.2	SW7470	08/04/95	08/07/95
Selenium	ND	1	1.0	SW6010	08/03/95	08/07/95
Silver	ND	0.1	5.0	SW6010	08/03/95	08/07/95

NOTES AND DEFINITIONS FOR THIS SAMPLE.
ICP METALS HAVE ELEVATED DETECTION LIMITS
IN ORDER TO ELIMINATE POSSIBLE INTERFERENCES
NA = NOT ANALYZED
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)

Test Code: **BULKID**
Sample Description: **95040770/GL950179**
Test Description: **Waste Solvent ID**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **N/A**

Analyst: DIH Date: 08/04/95 Instrument: TOC Verified: SDT

COMPONENTS	RESULT
Water	>99%

NOTES AND DEFINITIONS FOR THIS SAMPLE
ND = NOT DETECTED

Test Code: **TC_PH1**
Sample Description: **95040770/GL950179**
Test Description: **TCLP Pesticides**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8080**

Analyst: ECL
Instrument: HP_4R

Extracted: 08/03/95
Injected: 08/04/95

File #: 060R0101
Factor: 2

Units: ug/L

TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D012	72-20-8	Endrin	ND	0.20	20
D013	58-89-9	Lindane	ND	0.10	400
D014	72-43-5	Methoxychlor	ND	1.0	10000
D015	8001-35-2	Toxaphene	ND	2.0	500
D020	57-74-9	Chlordane	ND	1.0	30
D031	76-44-8	Heptachlor	ND	0.10	8

NOTES AND DEFINITIONS FOR THIS SAMPLE.
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
NA = NOT ANALYZED

Test Code: **TC_PH2**
Sample Description: **95040770/GL950179**
Test Description: **TCLP Herbicides**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8150**

Analyst: ECL
Instrument: HP_1F

Extracted: 08/03/95
Injected: 08/08/95

File #: 006F0101
Factor: 2

Units: ug/L

TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D016	94-75-7	2,4-D	ND	20	10000
D017	93-72-1	2,4,5-TP (Silvex)	ND	4.0	1000

NOTES AND DEFINITIONS FOR THIS SAMPLE.
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
NA = NOT ANALYZED

Test Code: **TC_SV**
Sample Description: **95040770/GL950179**
Test Description: **TCLP Semivolatiles**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8270**

Analyst: JLH
Instrument: HPMS_4
Extracted: 08/03/95
Injected: 08/08/95
File #: BR00525
Factor: 4
Units: ug/L
TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D023	95-48-7	o-Cresol	ND	20	200000
D024	108-39-4	m-Cresol*	ND	20	200000
D025	106-44-5	p-Cresol*	ND	20	200000
D027	106-46-7	1,4-Dichlorobenzene	ND	20	7500
D030	121-14-2	2,4-Dinitrotoluene	ND	20	130
D032	118-74-1	Hexachlorobenzene	ND	20	130
D033	87-68-3	Hexachlorobutadiene	ND	20	500
D034	67-72-1	Hexachloroethane	ND	20	3000
D036	98-95-3	Nitrobenzene	ND	20	2000
D037	87-86-5	Pentachlorophenol	ND	100	100000
D038	110-86-1	Pyridine	ND	20	5000
D041	95-95-4	2,4,5-Trichlorophenol	ND	100	400000
D042	88-06-2	2,4,6-Trichlorophenol	ND	20	2000

NOTES AND DEFINITIONS FOR THIS SAMPLE
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
* = UNRESOLVABLE COMPOUNDS

Test Code: **TC_VOA**
Sample Description: **95040770/GL950179**
Test Description: **TCLP Volatile Compounds**

Lab No: **01A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8240**

Analyst: SLT
Instrument: HPMS_1
Injected: 08/07/95
File #: 1BR08078
Factor: 10
Units: ug/L
TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D018	71-43-2	Benzene	ND	50	500
D019	56-23-5	Carbon tetrachloride	ND	50	500
D021	108-90-7	Chlorobenzene	ND	50	100000
D022	67-66-3	Chloroform	ND	50	6000
D028	107-06-2	1,2-Dichloroethane	ND	50	500
D029	75-35-4	1,1-Dichloroethene	ND	50	700
D035	78-93-3	Methyl ethyl ketone	ND	1000	200000
D039	127-18-4	Tetrachloroethene	ND	50	700
D040	79-01-6	Trichloroethene	ND	50	500
D043	75-01-4	Vinyl chloride	ND	100	200

NOTES AND DEFINITIONS FOR THIS SAMPLE
DET LIMIT = DETECTION LIMIT
NA = NOT ANALYZED
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
* = SEMI-QUANTITATIVE SCREEN ONLY

SAMPLE ID: 02 **95040771/GL950180** Collected: **07/27/95 14:00** Category: **WASTE**

TEST DESCRIPTION	RESULT	DETECTION LIMIT	UNITS	DATE ANALYZED	BY	METHOD
pH (Lab) - Solid Matrix	6.6		S.U.	08/04/95	PJH	9045
Reactivity, Cyanide	<10	10	mg/kg HCN	08/09/95	JWR	846/7.3.3.2
Reactivity, Sulfide	<100	100	mg/kg H2S	08/08/95	SCM	846/7.3.4.1

Order # N5-08-012
August 15, 1995 11:14
To: BROOKS AFB AL/OEAT

KEMRON ENVIRONMENTAL SERVICES
TEST RESULTS BY SAMPLE

Test Code: **AFTCME**
Sample Description: **95040771/GL950180**
Test Description: **TCLP Metals**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**

TCLP Extraction Date: 08/02/95
Units: mg/L
Verified: CLC

TCLP ANALYTES

METALS	RESULTS	DETECTION LIMIT	REGULATORY LIMIT	METHOD	PREPARATION DATE	ANALYSIS DATE
Arsenic	ND	1	5.0	SW6010	08/07/95	08/08/95
Barium	1.0	0.1	100.0	SW6010	08/07/95	08/08/95
Cadmium	ND	0.1	1.0	SW6010	08/07/95	08/08/95
Chromium	ND	0.2	5.0	SW6010	08/07/95	08/08/95
Lead	ND	1	5.0	SW6010	08/07/95	08/08/95
Mercury	ND	0.1	0.2	SW7470	08/04/95	08/07/95
Selenium	ND	1	1.0	SW6010	08/07/95	08/08/95
Silver	ND	0.1	5.0	SW6010	08/07/95	08/08/95

NOTES AND DEFINITIONS FOR THIS SAMPLE.
ICP METALS HAVE ELEVATED DETECTION LIMITS
IN ORDER TO ELIMINATE POSSIBLE INTERFERENCES
NA = NOT ANALYZED
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)

REQUESTING AGENCY: 92-AD106-951486/Eielson

Test Code: **BULKID**
Sample Description: **95040771/GL950180**
Test Description: **Waste Solvent ID**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **N/A**

Analyst: DIH

Date: 08/11/95

Instrument: TOC

Verified: SDT

COMPONENTS	RESULT
Water	>97%

NOTES AND DEFINITIONS FOR THIS SAMPLE
ND = NOT DETECTED

REQUESTING AGENCY: 92-AD106-951486/Eielson

KEMRON ENVIRONMENTAL SERVICES
TEST RESULTS BY SAMPLE

Test Code: **TC_PH1**
Sample Description: **95040771/GL950180**
Test Description: **TCLP Pesticides**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8080**

Analyst: ECL
Instrument: HP_4R
Extracted: 08/03/95
Injected: 08/04/95
File #: 061R0101
Factor: 2
Units: ug/L
TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D012	72-20-8	Endrin	ND	0.20	20
D013	58-89-9	Lindane	ND	0.10	400
D014	72-43-5	Methoxychlor	ND	1.0	10000
D015	8001-35-2	Toxaphene	ND	2.0	500
D020	57-74-9	Chlordane	ND	1.0	30
D031	76-44-8	Heptachlor	ND	0.10	8

NOTES AND DEFINITIONS FOR THIS SAMPLE.
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD DETECTION LIMIT (MDL)
NA = NOT ANALYZED

REQUESTING AGENCY: 92-AD106-951486/Eielson

KEMRON ENVIRONMENTAL SERVICES
TEST RESULTS BY SAMPLE

Test Code: **TC_PH2**
Sample Description: **95040771/GL950180**
Test Description: **TCLP Herbicides**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8150**

Analyst: ECL
Instrument: HP_1F
Extracted: 08/03/95
Injected: 08/08/95
File #: 007F0101
Factor: 2
Units: ug/L
TCLP Extraction Date: 08/02/95
Verified: SDT.

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D016	94-75-7	2,4-D	ND	20	10000
D017	93-72-1	2,4,5-TP (Silvex)	ND	4.0	1000

NOTES AND DEFINITIONS FOR THIS SAMPLE.
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
NA = NOT ANALYZED

Test Code: **TC_SV**
Sample Description: **95040771/GL950180**
Test Description: **TCLP Semivolatiles**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8270**

Analyst: JLH
Instrument: HPMS_4
Extracted: 08/03/95
Injected: 08/09/95
File #: BR00526
Factor: 4
Units: ug/L
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D023	95-48-7	o-Cresol	ND	20	200000
D024	108-39-4	m-Cresol*	ND	20	200000
D025	106-44-5	p-Cresol*	ND	20	200000
D027	106-46-7	1,4-Dichlorobenzene	ND	20	7500
D030	121-14-2	2,4-Dinitrotoluene	ND	20	130
D032	118-74-1	Hexachlorobenzene	ND	20	130
D033	87-68-3	Hexachlorobutadiene	ND	20	500
D034	67-72-1	Hexachloroethane	ND	20	3000
D036	98-95-3	Nitrobenzene	ND	20	2000
D037	87-86-5	Pentachlorophenol	ND	100	100000
D038	110-86-1	Pyridine	ND	20	5000
D041	95-95-4	2,4,5-Trichlorophenol	ND	100	400000
D042	88-06-2	2,4,6-Trichlorophenol	ND	20	2000

NOTES AND DEFINITIONS FOR THIS SAMPLE
DET LIMIT = DETECTION LIMIT
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
* = UNRESOLVABLE COMPOUNDS

Test Code: **TC_VOA**
Sample Description: **95040771/GL950180**
Test Description: **TCLP Volatile Compounds**

Lab No: **02A**

Collected: **07/27/95 14:00**
Category: **WASTE**
Method: **8240**

Analyst: SLT
Instrument: HPMS_1
Injected: 08/07/95
File #: 1BR08079
Factor: 10
Units: ug/L
TCLP Extraction Date: 08/02/95
Verified: SDT

EPA HW#	CAS#	COMPOUND	RESULT	DETECTION LIMIT	REGULATORY LIMIT
D018	71-43-2	Benzene	ND	50	500
D019	56-23-5	Carbon tetrachloride	ND	50	500
D021	108-90-7	Chlorobenzene	ND	50	100000
D022	67-66-3	Chloroform	ND	50	6000
D028	107-06-2	1,2-Dichloroethane	ND	50	500
D029	75-35-4	1,1-Dichloroethene	ND	50	700
D035	78-93-3	Methyl ethyl ketone	ND	1000	200000
D039	127-18-4	Tetrachloroethene	ND	50	700
D040	79-01-6	Trichloroethene	ND	50	500
D043	75-01-4	Vinyl chloride	ND	100	200

NOTES AND DEFINITIONS FOR THIS SAMPLE
DET LIMIT = DETECTION LIMIT
NA = NOT ANALYZED
ND = NOT DETECTED AT OR ABOVE THE METHOD
DETECTION LIMIT (MDL)
* = SEMI-QUANTITATIVE SCREEN ONLY

Identification of major components employing any of the following:
- Solubility Tests - Water,hexane,acetone
- IR Spectra of Liquids and Vapors
- GC/FID Screening and Fingerprinting
- GC/MS by solvent dilution/direct injection

SW-846 Method 9045 (Electrometric) - pH

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods
(SW-846) Third Edition, Proposed Update I, Section 7.3.3.2 - Cyanide Reactivity

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods
(SW-846) Third Edition, Proposed Update I, Section 7.3.4.2 - Sulfide Reactivity

SW1311 (Bottle Extraction for Non-volatiles)

SW1311 (TCLP Rotary Extraction)
SW8080 (Pesticides)

SW1311 (TCLP Rotary Extraction)
SW8150 (Herbicides)

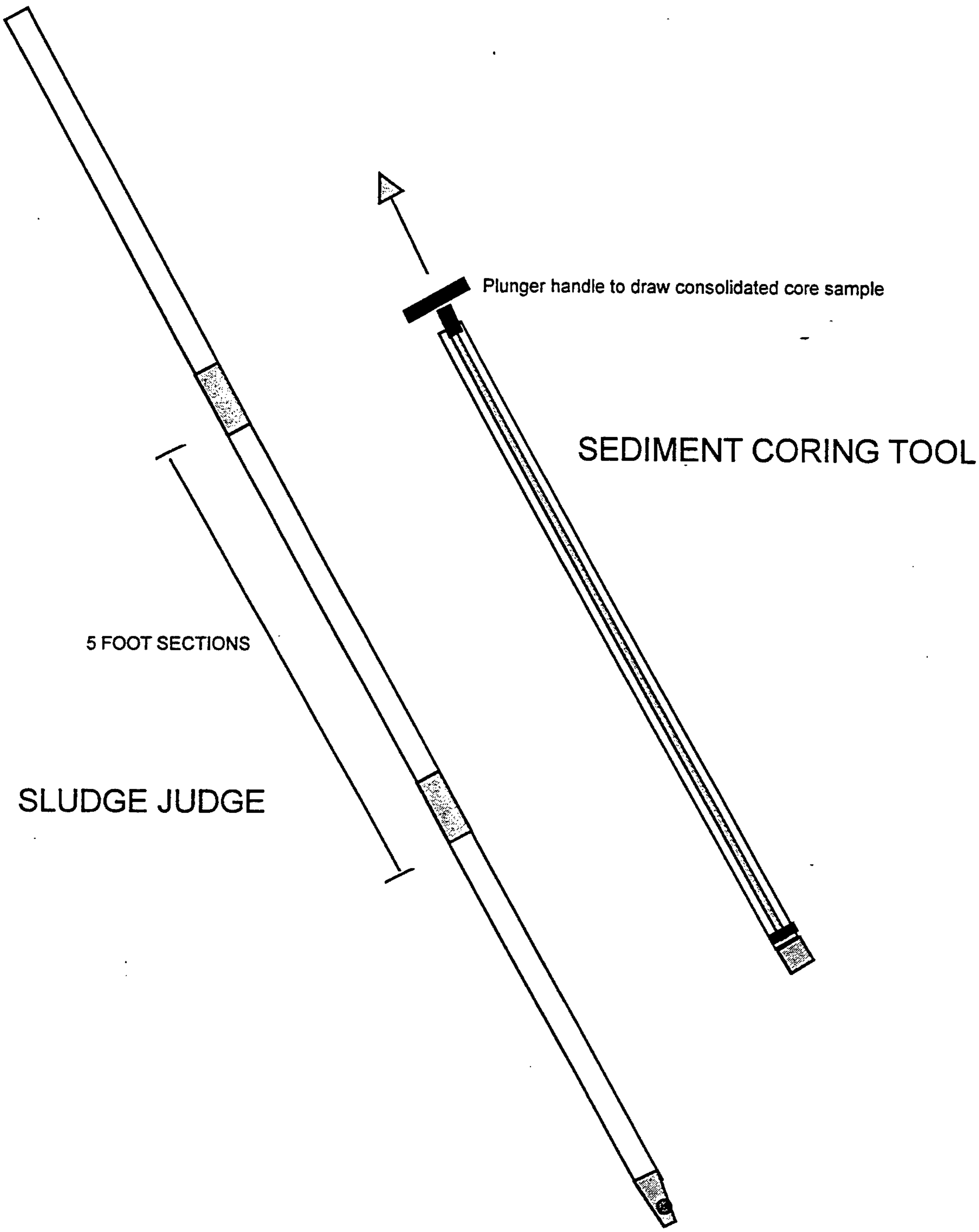
SW1311 (TCLP Rotary Extraction)
SW8270 (Semivolatile Compounds)

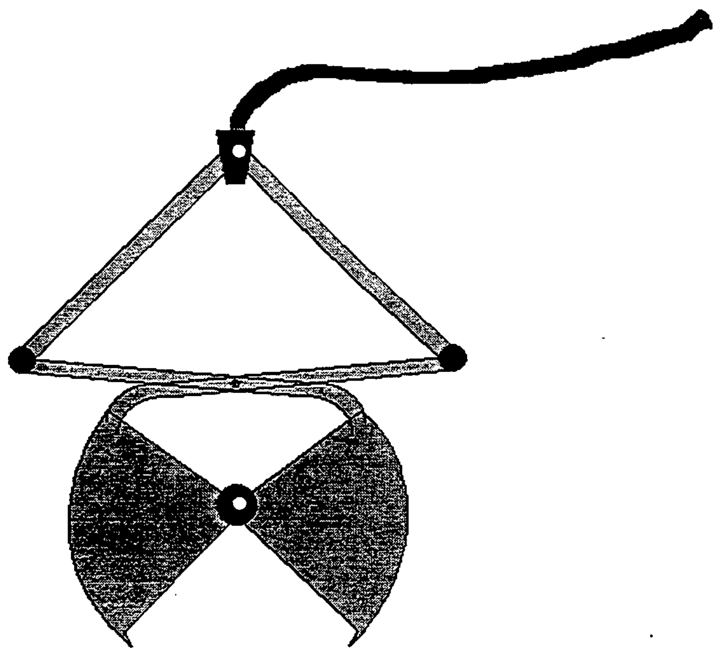
SW1311 (TCLP Extraction - ZHE)
SW8240 (Volatile Compounds, modified for megabore column)

SW1311 (Zero Headspace Extraction)

APPENDIX D

Sampling Equipment


Plunger handle to draw consolidated core sample
SEDIMENT CORING TOOL
5 FOOT SECTIONS
SLUDGE JUDGE



PONAR DREDGE SAMPLER